



(14) (2) If a target object is a three-dimensional object and has a depth and an uneven surface pattern, the appearance (area, shape, and the like) of the object changes in different directions.

(15) (3) If a target object is not a perfectly rigid object (e.g., a man wearing clothing), the shape of the object changes at each time point.

(15) (4) If a portion of a background and a portion of a target object have the same **color** or luminance, the same color or luminance portion of the target object is not detected as a changing area while the target object passes through the same color or luminance portion of the background.

(17) In the states wherein corresponding changing areas are not necessarily detected at each time point as described above, since corresponding changing areas may not be present, moving vectors may not be obtained. Therefore, the block association processing scheme may not properly function. If the block association processing scheme fails or does not properly function as described above, serious problems are posed when it is applied to a monitoring system (display monitoring system).

(18) In order to solve the above-described problems, a tracking means capable

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DISPLAY MONITORING SYSTEM FOR
DETECTING AND TRACKING AN ENTRANT IN
A MONITOR IMAGING
BACKGROUND OF THE INVENTION

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method of detecting a moving object by only detecting changes in the field of view.

(1) In addition to an existing object, noise caused by environmental variations is detected. It is difficult to distinguish a moving object from the noise. Noise components caused by environmental variations correspond to changes in brightness due to illumination variations or changes in brightness as a given pixel due to reflection by a wear surface or the like of time, and it is difficult to detect a moving object from such noise.

(2) In the conventional method, therefore, objects to be detected cannot be reliably and selectively detected by removing the noise components.

(3) Even when changes are not necessarily observed in a difference image of the monitoring object, predicted (e.g., occurred) of the above-described noise, association of a plurality of changing areas originating from one object, determination of the presence-absence, position, and shape of the object, and subsequent to change area association processing must be performed.

(4) Since detection of noise on the line related to an existing object is not always perfect and the detection is not always perfect, the detection is very difficult to clearly separate the detection of the line from the noise. Therefore, it is very difficult to detect an object as one area in an image.

As a method of solving the above-described problems, a block association processing scheme (published in Unexamined Japanese Patent Application Nos. 2-55875, 2-55876, and 2-55877) has been proposed.

In the block association processing scheme as shown in FIG. 1, when an image is separated into a plurality of changing areas (e.g., head, body, and leg areas, in a difference image), corresponding change amounts between the changing areas assumed at two consecutive time points are obtained by subtracting feature amounts such as area and shape features. Moving vectors between the corresponding changing areas are then obtained and it is determined whether changing areas which have similar moving vectors originate from the same object. This scheme is effective as long as the object is

detected in the same monitoring processing scheme.

However, in the block association processing scheme, when the detection of a moving object is not perfect, the detection of a moving object is not perfect.

In order to solve the above-described problems, a tracking means capable of tracking a moving object is proposed.

According to the tracking method of the tracking means, a portion to be tracked, such as a number (e.g., 1) of a moving object, is determined in advance. Therefore, it is impossible to track a moving object which is not tracked in advance.

As a method of tracking a moving object in a monitoring system, the following method is proposed. This method employs a change detecting means for detecting a changing area which changes due to the occurrence of a moving object such as an intruder, with a tracking means associated for the changing area detected by the change detecting means. With this arrangement, the moving object presumed to be present in the changing area is tracked.

For example, the following tracking method is proposed by the tracking means described above.

(1) Tracking changes in brightness (pixel features) in a monitoring area.

(2) Tracking a specific area in a monitoring area and determining a moving direction by calculating the correlation value between a tracking area and peripheral areas.

Since a given tracking means can track only a portion of a moving object, the following method is also proposed. In this method, after tracking processing is completed, tracking results are analyzed, and the tracking areas are divided into groups of moving objects (e.g., the tracking areas are assumed to group

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(94) (4) In the above embodiments, changes are considered only in terms of brightness. However, a method of detecting changes on the basis of changes in **color** or texture may be simply used depending on an application. If it is known in advance that a target object has a specific color, a change can be reliably detected by detecting a change in color or by assembling a plurality of change detections. In this case, depending on a target object, a change can be properly detected only by certain processing. In such a case, the method used in the change detection should be transferred to the tracking step so that tracking processing is also performed in consideration of the used method, thus improving the reliability of processing.

(95) (5) In the above embodiments, only the sizes of changing areas are taken into consideration to determine which one of the areas is to be tracked. However, if a changing area is selected in consideration of information about the shapes of changing areas in addition to their sizes, a target can be more reliably selected. Since the contour of a still object tends to be mistaken for a changing portion due to the difference between the contour and the background, the following processing may be additionally performed: removing edges such as the contour mentioned above, or neglecting changes occurring at

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DISPLAY MONITORING SYSTEM FOR
DETECTING AND TRACKING AN INTRUDER IN
A MINUTER ARRANGEMENT

BACKGROUND OF THE INVENTION

As is well known, the present invention relates to a system for detecting and tracking an intruder in a minuter arrangement. In the prior art, a change in brightness of a target object is detected by a sensor. However, a change in brightness of a target object is not necessarily accompanied by a change in color or texture. For example, the present invention relates to a system for detecting and tracking an intruder in a minuter arrangement.

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method of detecting a moving object by only detecting

changes on the basis of such differences.

(1) In addition to an existing object, noise caused by environmental variations is detected. It is difficult to discriminate an existing object from the noise. Noise components caused by environmental variations correspond to changes in brightness of a given part due to reflection by a wall surface or the floor of a room, and it causes large differences in picture when an existing object is in the environmental method. Therefore, objects to be detected cannot be reliably and selectively detected by removing the noise components.

(2) Noise and changing area data are necessarily supplied to a difference image of the existing object, produced by the above-mentioned noise.

According to a plurality of changing area data obtained from one object, discrimination of the presence/absence, position, and shape of the existing object is required to change area extraction processing must be accurately performed.

(3) Since information of size of the target is an important factor for tracking, it is very difficult to detect a moving object such as an intruder, with a tracking means used for the changing area detected by the change detecting means. With this arrangement, the moving object presented to be present in the changing area is tracked.

As a method of solving the above-mentioned problems, a video monitoring processing system is disclosed in FIG. 1, where a monitor is connected to a plurality of changing area data, such as head, body, and leg area, in a difference image, corresponding change elements between the changing area extracted at two consecutive time points are obtained by tracking feature vectors such as area and shape factors. Moving vectors between the corresponding changing area are also obtained and it is determined whether the changing area which have similar moving vectors originate from the same object. This process is effective as long as the object is

detected by the above-mentioned processing system

may not properly function. If the above-mentioned processing system fails or does not properly function, the above-mentioned problems are posed when it is applied to a monitoring system (display monitoring system).

In order to solve the above-mentioned problems, a tracking means capable of tracking a moving object is employed in some cases. In the above-mentioned tracking means, since a moving object is tracked, movement between areas need not be performed. However, the tracking means of this system is used to track, e.g., the movement of a target being in many cases.

According to the tracking method of the tracking means, a portion to be tracked, e.g., a marker (tag) attached to an object to be presented (e.g., an area tag) of a mark, must be distinguished in advance. Therefore, it is impossible to immediately detect many unexpected and unwanted in a monitoring area and track them.

As a method of tracking unexpected targets in a monitoring area, the following method is also proposed. The method employs a change detecting means for detecting a changing area which changes due to the movement of a moving object such as an intruder, with a tracking means used for the changing area detected by the change detecting means. With this arrangement, the moving object presented to be present in the changing area is tracked.

For example, the following tracking methods are proposed by the tracking means described above:

(1) Tracking changes in brightness (pixel luminance) in a tracking area;

(2) Tracking a specific feature in a tracking area; and

(3) Determining a moving direction by monitoring the correlation value between a tracking area and peripheral areas.

Since a given existing means and track only a portion of a moving object, the following method is also proposed. In this method, after tracking processing is completed, tracking results are analyzed, and the tracking means are divided into groups in order of moving objects (e.g., the tracking means are associated to groups

(111) (2) The estimation function used for calculating the association strengths between the tracking units in candidate extraction processing may be replaced with the process for extracting a candidate for a moving object by using knowledge associated with the positions

decks organized into the same structural elements. In many cases, however, a changing grid occurred on the basis of a difference does not necessarily amount to a specific portion of an object.

For example, the passage was

(1) Character or individual size or shape, being variable.

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19 *any properly functioning*. In the latter assumption
20 *proceeding above that it does not properly function* is
21 *proceeding above, which proceeds as now what is*
22 *applied to a monitoring system (display monitoring)*
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As a method of tracking suspended barges in a river for sale, the following method is now proposed. The method employs a change detecting means for detecting a changing area which changes due to the moving of a moving object, such as an barge, with a tracking means arranged for the changing area detected by the change detecting means. With this arrangement, the moving object presumed to be present in the changing area is tracked.

(c) tracking changes in brightness (red, green, blue)

to a tracking area;
 4) tracking a specific source in a tracking area; and
 5) determining a routing direction by calculating the
 correlation value between a tracking area and peripheral
 areas.

There is given tracking areas and there is only a portion
 of a moving object, the following method is also pro-
 posed. In the method, after tracking processing is com-
 pleted, tracking results are analyzed, and the tracking
 areas are divided into groups in terms of moving ob-
 jects. In the tracking areas, the correlation is shown

(112) An example of this processing will be described below. Processing modules are prepared. Each module compares the respective information described above between two tracking units and converts the comparison result into numerical values indicating whether the compared information are close to each other (i.e., moving objects resemble each other or the same moving object is tracked). Output results from the respective processing modules may be simply added together. Alternatively, the priorities of the respective information are determined, and a weighted sum obtained by weighting in accordance with the priorities is used as an association strength. For example, by using information associated with the shape of an intruder, the probability of obtaining an accurate result

the eye expanded into the same unadorned elements. In every case, however, a changing eye evolved on the basis of a difference that not necessarily corresponded to a specific portion of an object.

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As a method of teaching suspended harp in a western harp, the following method is also proposed. This method employs a change of stringing method for detuning a vibrating wire which changes due to the varying

82 extent of a moving object such as an traveler, with a stringing method and the changing method of the changing method. With this arrangement, the moving object is used to be present in the changing

For example, the following trading methods are employed by the trading system described herein:

- (1) trading charges or brightness (gold income) is a trading area;
- (2) trading a specific force in a trading area; and
- (3) determining a trading direction by measuring the correlation value between a trading area and people and areas.

Table 5 gives trading means and shows only a portion of the trading means. The trading method is also improved. In the method, after trading, according to a completed, trading means are divided, and the trading means are divided into groups to meet the needs of trading, such as the trading means are trading in a trading area.

